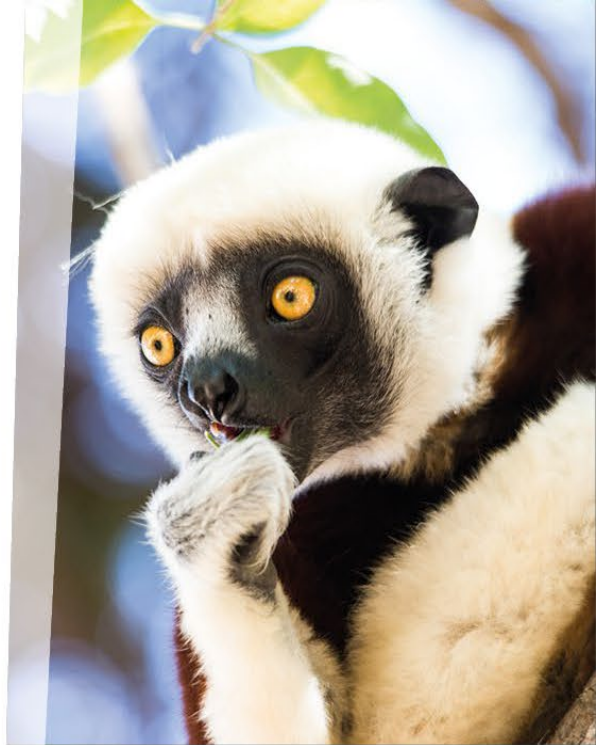


OPERATION WALLACEA

Madagascar School's Booklet 2027



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1. Study area and research objectives

As well as boasting some of the most spectacular biodiversity in the world (lemurs, tenrecs, baobabs, and over half of all known chameleon species), much of which is endemic, Madagascar has three broad forest ecosystem types: dry forests in the north, humid rainforest in the east, and spiny forest in the south. The Operation Wallacea surveys are currently concentrating on the dry forest and associated wetlands of Mahamavo in the North, where you will spend your first week. The second week will be spent at a marine research site on the small island of Nosy Be off the Northwest coast of Madagascar (see fig 1 for locations).



Figure 1. Location of the Madagascar research sites

Mahamavo Forest

The Mahamavo dry forest ecosystem and adjacent wetlands has exceptional biodiversity, but much remains to be discovered. Diurnal lemurs include Coquerel's sifaka (*Propithecus coquereli*), common brown lemur (*Eulemur fulvus*), mongoose lemur (*Eulemur mongoz*), with another 3-4 species of nocturnal lemurs. Madagascar is the global centre for chameleons. Two spectacular large species can be found in Mahamavo; *Furcifer oustaleti* and *Furcifer angeli*. The wetlands support the critically endangered Madagascar fish eagle (*Haliaeetus vociferoides*), a flagship species for the area of which only 99 breeding pairs remain in the wild, and Humblot's heron (*Ardea humbloti*), an endangered species.

The Mahamavo forest provides livelihoods for several neighbouring communities in terms of agricultural land, fuel and construction timber, as well as some wild food, hunting and medicinal plants. The wetlands in the coastal area support fisheries, which constitute the main resources for coastal communities. Although this area encompasses all of these land uses, there still remains intact forest that is managed by the local community. The teams in the Mahamavo forests will be completing an assessment of the area in terms of biodiversity along stratified sampling routes (Fig 2).

The objectives of this to be to monitor how the forest structure and biodiversity changes over time in the community managed forests of Mahamavo to document the performance of a community managed area in terms of biodiversity conservation. In addition the Opwall teams are now starting to look at the possibilities for alternative livelihoods for the local community, with a particular focus on the possibility of ecotourism.

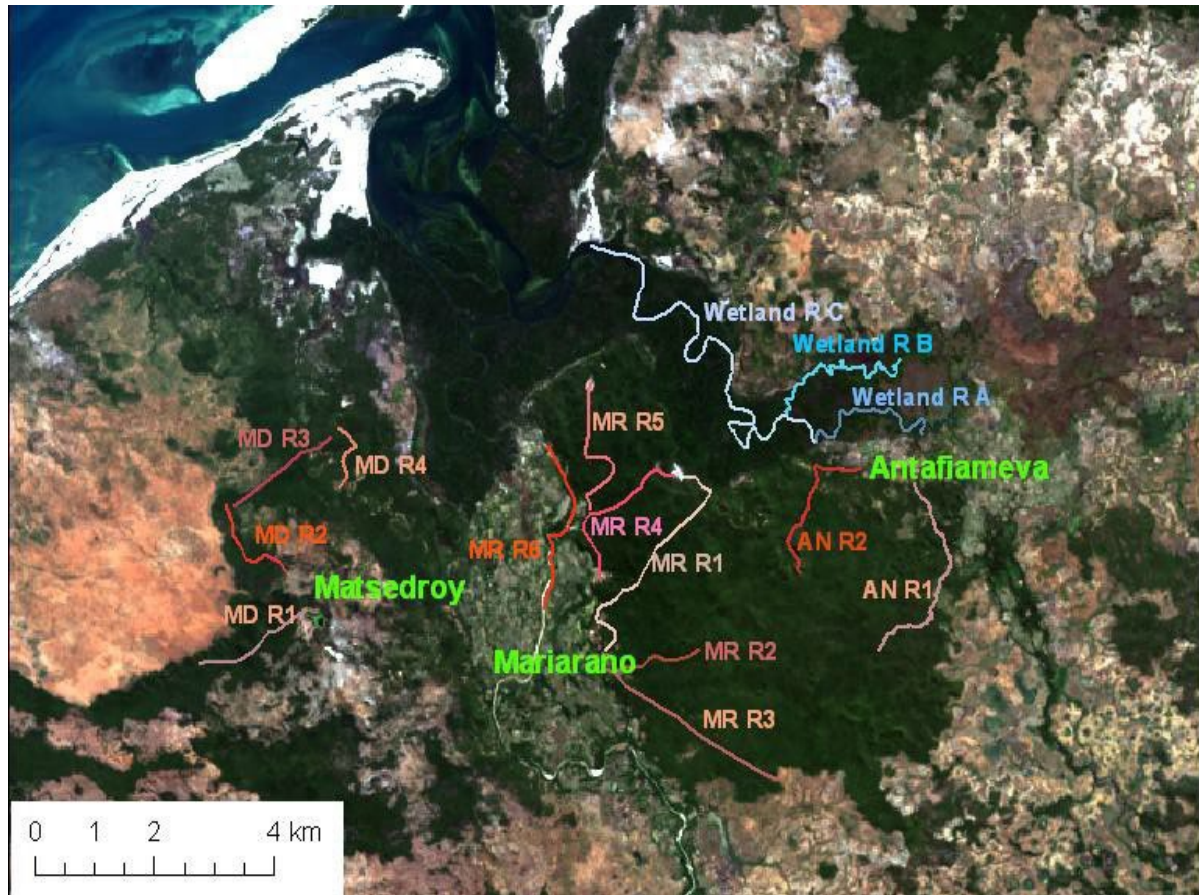


Figure 2. Location of the Mahamavo research sites and stratified sampling routes

Nosy Be

Despite plans by the Madagascan government to expand its network of marine protected areas (MPAs), the country's coral reefs remain under threat from local pressures such as overfishing, and global threats such as climate change. However, surveys by the World Conservation Society found the reefs around islands near Nosy Be, off Madagascar's northwest coast, to be amongst the healthiest anywhere in the Western Indian Ocean. They found live coral cover to have increased in recent years, and fish biomass to be at carrying capacity.

The larger island of Nosy Be is home to a sizeable human population and a bustling tourism industry, likely placing the surrounding coral reefs under increased pressure. Opwall will be working along a gradient of reef protection, from the strictly protected MPA at Nosy Tanikely to unmanaged reefs further along the coast. Our aims are to establish a technology-driven standardised reef monitoring program which can be combined with data sets from other key bioregions to explore patterns in coral reef functioning from present to future. Via this programme we will then collect long term reef health data across this human use gradient to compare the performance of reefs around Nosy Be to those of more remote locations nearby.

2. Week 1: Itinerary in Mahamavo

The students on site will complete five days of training and research. There are two different sites in Mahamavo, base camp at Mariarano village, and a secondary camp at Matsedroy. The school groups arrive at base camp/Matsedroy on Thursday and settle in with an evening orientation lecture. Groups will spend three nights at either base camp in Mariarano village or Matsedroy camp and the remaining three nights at the other camp (see table 1 for a rough schedule). On the Wednesday morning the groups will reconvene at base camp in preparation for their transfer to the marine site at Nosy Be.

Table 1. Indicative timetable for groups starting in Mariarano basecamp. N.B. this table is just an example timetable, the exact timetabling will vary depending on level of fitness, research activities taking place and weather conditions. We endeavour to ensure all students participate in each activity at least once during the trip and stay at both camps.

Time	Schedule A (Mariarano/Matsedroy)
Thursday lunchtime	Arrival at Mariarano Base Camp Introduction to camp, and health and safety talk
Thursday night	Research activities. One from: - Lemur opportunistic sampling - Herp opportunistic sampling - Invertebrate surveys
Friday morning	Research activities. One from: - Herp route - Lemur route - Forest bird point counts - Bird mist netting - Butterfly surveys
Friday afternoon	Lecture 1: An Introduction to Madagascar and Mahamavo Research activities. One from: - Forest structure plot - Malagasy language class/cultural activity - Workshop activity
Friday night	Research activities. One from: - Lemur opportunistic sampling - Herp opportunistic sampling - Invertebrate surveys
Saturday morning	Research activities. One from: - Herp route - Lemur route - Forest bird point counts - Bird mist netting - Butterfly surveys

Saturday afternoon	Lecture 2: Biodiversity, Evolution and Endemism in Madagascar Research activities. One from: - Forest structure plot - Malagasy language class/cultural activity - Workshop activity
Saturday night	Research activities. One from: - Lemur opportunistic sampling - Herp opportunistic sampling - Invertebrate surveys
Sunday morning	Research activities. One from: - Herp route - Lemur route - Forest bird point counts - Bird mist netting - Butterfly surveys
Sunday afternoon	Lecture 3: Biodiversity of Mahamavo Trek from Mariarano Base Camp to Matsedroy Satellite Camp
Sunday night	Research activities. One from: - Lemur opportunistic sampling - Herp opportunistic sampling - Invertebrate surveys
Monday morning	Research activities. One from: - Herp route - Lemur route - Forest bird point counts - Bird mist netting - Butterfly surveys
Monday afternoon	Lecture 4: People, Culture and History in relation to conservation Research activities. One from: - Forest structure plot - Malagasy language class/cultural activity - Workshop activity
Monday night	Research activities. One from: - Lemur opportunistic sampling - Herp opportunistic sampling - Invertebrate surveys

Tuesday morning	Research activities. One from: - Herp route - Lemur route - Forest bird point counts - Bird mist netting - Butterfly surveys
Tuesday afternoon	Lecture 5: Conservation in Madagascar Research activities. One from: - Forest structure plot - Malagasy language class/cultural activity - Workshop activity
Tuesday night	Quiz night or survey sign up system
Wednesday morning	Trek from Matsedroy to Mariarano Leave the forest site to start transfer to Nosy Be

3. Research activities

Morning Activities

Herpetofauna routes (both camps)

In the course of this activity, a small group of students led by a herpetologist and accompanied by a local guide will walk slowly along a forest sample route. Everyone needs to scan the vegetation and ground carefully for reptiles and amphibians since many species are quite cryptic.

When an individual is detected it will be caught (by the trained herpetologist) and the species and location are recorded. Certain morphometric measurements will also be taken. If the species is common all data will be recorded there and then, however more unusual species will be taken back to the camp for photographing and later identification with field guides and keys before the specimen is returned to the location it was caught.

Lemur routes (both camps)

The aim of this activity is to estimate encounter rates, densities and population sizes of day-time lemurs using distance sampling. Groups walk slowly along the route with a lemur specialist and local guide scanning the canopy closely for groups of lemurs. When a group is detected we record the location, the species, the group size and the distance from the route centreline.

Bird point counts (both camps)

Although one will see a lot of birds while walking in the forest, by listening carefully many more can be detected. During a static point count, the majority of observations are actually of bird calls. For this reason

students will receive an evening briefing before taking part in point counts in which we will use flash cards and sound recording to teach students the calls of 20 common species. We will also brief student on the key identification points for the commoner forest birds.

In the course of a point count activity, students will walk along a sample route in the early morning with a member of the ornithology team and a local guide, stopping at several sample sites for 10 minutes to undertake point counts. When a group of birds is detected the team will record the species, the group size, the estimated distance to the birds and the method of observation (seen, heard, seen and heard).

Bird mist netting (Mariarano camp)

Mist netting is undertaken in order for students to see this sampling technique first hand and to sample cryptic forest bird species which might not be detected by point counts. Nets will be set up in a location that birds are likely to fly through, e.g. a break in the forest. The area of nets and the time open will be recorded in order to compare against other sampling efforts, no matter the duration or time of day.

When birds are caught, the trained ornithologist will demonstrate how they are removed from the net and handled. Each individual will be identified to species and students will be encouraged to make the identifications themselves, if necessary with reference to copies of field guides. The ornithologist will demonstrate how to take standard morpho-metric measurements (wing, tarsus, head, and tail with metal rulers) and weights are taken with a Pesola balance and bag. Birds will also be metal ringed with SAFRINGS. Blood samples might be taken. Students will help in these activities by passing equipment or scribing or by making measurements on birds handled by the ornithologist.

Butterfly Survey

The aim of this activity is to identify and estimate the abundance of butterflies using a pollard count. Groups walk slowly along the route with an invertebrate specialist and local guide scanning a 2.5 metre area around them, if a butterfly is seen the species is identified and recorded. If the species is hard to identify in air then it should be caught with a net so a closer inspection can be made and the species identified.

Afternoon Activities

Wetland bird counts (Matsedroy camp)

This is quite a simple opportunistic sampling activity. Volunteers will visit three beautiful freshwater lakes on foot in the course of 2 hours accompanied by an ornithologist and local guides and make counts of wetland birds on each lake on that sampling occasion. The students will notice that the bird communities that live in and around these lakes differ hugely from those that live in and around the estuarine areas.

Forest structure plots (both camps)

The aim of making measurements in a stratified sample of plots in the forests in Mahamavo with the aim of tracking changes in the biophysical properties of the forest such as canopy height, sapling density and basal area. We hope that each school volunteer will be able to assist with 2 plots during their time in Mahamavo. Students will make measurements on forest plots in groups of 6-8 with a team leader and local guide.

The team navigates along the sample route using the 'go to' function on their GPS until they find the sample site to be surveyed. Plot locations are marked at their NW corner by a piece of labelled pink flagging tape

on the sample route. Plots are 20m squares. Upon arrival at a plot the team must lay a 20m measuring tape from the marked corner backwards along the sample route toward the start of the route. Next, the group must measure the bearing along this tape and calculate two bearings normal to this (at 90 degrees) on either side of the route. The bearing which is closest to north is selected to decide whether the plot will be positioned on the right or left of the route. Following this algorithm ensures that plots are positioned in the same location relative to the defined corner every year. Two students will then take a 20m measuring tape and a compass and follow the selected bearing for 20m into the forest at both ends of the original tape laid along the sample route. By this stage the group should have marked three sides of a 20m square plot. At this point, the groups should be able to judge whether the plot is going to turn out in a square, if it isn't they need to check the bearings and re-plot the area. Now the team should distribute the measuring equipment and arrange themselves along the sample route edge of the plot at 3-4m intervals with the team leader in the centre. Now everyone walks slowly into the plot until they are lined up along the back edge.

Next, the team slowly moves back towards the sample route. Every time that a woody stem is encountered that is greater than 5cm in diameter (this will be demonstrated first with some example of too small and big enough stems) the student should use a short measuring tape to measure the circumference of the stem (in cm) at breast height i.e. about 1.3m above the ground. They need to call out this measurement to the team leader who will write it down. They must also estimate the height of the tree and call this out to the team leader. During this activity the volunteers need to co-ordinate with their neighbours on their left and right sides to ensure all stems are counted (none missed, none measured twice). Eventually after about 15m everyone will end up back on the sample route.

The students then need to each go to ten random locations in the plot and estimate canopy cover. This is accomplished with a canopy scope (a plastic CD jewel case cover marked with 25 black dots). This is held towards the sky at arm's length and the number of black dots with sky behind counted and reported to the team leader.

Next four pieces of cord 8m long are stretched out in 4 random locations in the plot to form four 2m square quadrats. The students then need to count the number of woody stems (of any size, including the tiniest 1mm wide) in the plot and report this to the team leader.

Malagasy language class/cultural activities (both camps)

During your stay in the Mahamavo forest we endeavour to integrate with the local community as much as possible. Learning some key words and phrases can go a long way, particularly when no one in the village speaks any English, so we encourage the learning of a few simple phrases while you are in the forest. In Mariarano there is a village school, and if this is open during your stay we will see if a short visit can be arranged in order to meet the local children. If you wish you can bring pencils, crayons, chalks, pens, French: English dictionaries, footballs and toys and this will be accepted gladly! We also meet local people and are able to watch local crafts such as basket and mat-making taking place. There is a football pitch in the village and fun matches can be arranged with the locals too. In Matsedroy we aim to have at least one evening learning local dances and listening to Malagasy music, often played on traditional instruments, plus sporting activities with the local guides and staff such as boules and football.

Workshop Activity

Each scientist on site will prepare a small workshop/activity so depending on their area of research/interest this will vary. Examples of workshops include bird ID skills, debate session, guest lecture etc.

Evening Activities

Herp routes at night (both camps)

Methods for herp routes are the same at night as they are by day. The reason for sampling at night is that a different community of reptiles and amphibians is active so it's necessary to sample by day and night to record them all. Additionally, dissertation students investigating niche separation and colour change in chameleons and geckos (which are more easy to find at night) will collect data on each individual in-situ including height above ground, canopy cover above individual, branch circumference where found, temperature of individual and substrate where found and individual body length (excluding and including tail). Chameleons and geckos will be caught and taken to camp for analysis using a field spectrometer and will be released at the location where they were found the next day. The team leader carries a massive torch for spotlighting reptiles. Everyone else needs their own head torch.

Lemur routes at night (both camps)

Aims and methods as for lemur routes by day. The reason for sampling at night is that a different community of lemurs is active so it is necessary to sample by day and night to record them all. It's also much more likely that rare carnivores e.g. Falanouc (*Eupleres goudotti*) will be sighted opportunistically at night.

Invertebrate Surveys (both camps)

Invertebrates are one of the most numerous and diverse taxa on the planet but are often overlooked. Students will be able to assist an entomologist in sampling for spiders in Mahamavo many of which are new to science. Students will be split into groups of 6 and be tasked with catching whatever insects they find within a specified search area. Students will then come back to camp and be taught how to prepare specimens and help create a reference collection of the area.

4. Lectures and learning outcomes

Lecture 1: An introduction to Madagascar and Mahamavo

An introduction to the habitats and biodiversity of Madagascar. Students will also learn about the threats to wildlife and the aims of the scientific work they will be involved in.

A Level keywords

- Biodiversity; conservation; sustainability; threats; ecosystems;

Discussion/Activity – if time, a brief quiz/info session on the geography of Madagascar.

Lecture 2: Biodiversity, Evolution and Endemism in Madagascar

An introduction to evolution and the unique situation of Madagascar. Students will learn about the biogeography of the island and why there are such high numbers of unusual species. The early impact of humans will also be discussed.

A level keywords

- Evolution; speciation; species; endemism; gene pool; variation; adaptive radiation; isolation
- Human impact

Discussion/Activity – Discussion on the word 'biodiversity'

Lecture 3: Biodiversity of Mahamavo – what is here and how do we monitor it?

This lecture looks at survey techniques used to monitor the various different taxonomic groups. It compares the advantages and disadvantages of different surveys.

A level keywords

- Ecological monitoring; Distance sampling, bird point count, capture methods

Discussion/Activity – The bird sampling activity – students are given a survey to plan and choose the most appropriate option.

Lecture 4: People, Culture and History in relation to conservation

This lecture looks at the geography, history, culture and heritage of Madagascar and what life holds for the modern Malagasy.

A level keywords

- Culture; globalization.

Discussion/Activity – Quiz on Madagascar

Lecture 5: Conservation in Madagascar

This lecture discusses conservation priorities and protected areas in Madagascar, looking at the conflicts between wildlife and people and the possible effects of climate change. It also looks at how data collected in Mahamavo can be used to see patterns and trends in biodiversity and its subsequent use in conservation management

A level keywords

- Biodiversity
- Conservation; management; national parks
- Human impact; climate change

Discussion/Activity – Which works better, in-situ or ex-situ conservation?

At the end of the week of practicals, lectures and discussion topics the students should have completed the following learning outcomes:

- Be able to describe the endemism of various Madagascar taxa
- Be able to identify the major habitats occurring across Madagascar and an understanding of the geography of Madagascar
- Be able to identify 10 endemic Madagascar birds
- To understand the assumptions upon which point counts are based
- Be able to identify 5 Malagasy herpetofauna species
- To understand different methods for surveying
- To be able to identify 5 mammal species
- Be able to describe how lemurs are unique and their social structure
- Understand the conservation management issues in Madagascar

5. Week 2: Itinerary in Nosy Be

The students will complete five days of marine education and training between their arrival on Nosy Be on Friday afternoon and their departure the following Thursday morning to start their journey home. These five days are structured according to the options selected for the week; Reef Ecology Course (with practicals by either diving or snorkeling), SSI Open Water or Dive Referral (see sections below). All participants will visit the marine protected area, Nosy Tanikely, on Wednesday and participate in a snorkeling trip.

6. Indian Ocean Reef Ecology Course

Table 2 shows an example timetable of the activities that students undertaking the Indian Ocean Coral Reef Ecology Course will complete over their week in Nosy Be. The timetable includes each of the elements that will be completed during the week but the timing of the sessions may vary. The practical element of the Reef Ecology Course can be completed by either diving or snorkeling. If students are already qualified divers by the time they arrive on site, they will be required to complete a compulsory check dive with a SSI Professional at the start of the course. The Indian Ocean Coral Reef Ecology course is designed to provide an introduction to coral reef ecology and other major tropical marine habitats. Lectures will be supported by in-water practicals. All boat based activities though are subject to safe launching conditions and if the waves are too high on a particular day then the boat based activities for that day will have to be cancelled and alternative practicals scheduled.

In addition to the lectures, students will also be expected to complete a small group task throughout the course of the week. Students will be provided with an information pack at the start of the week, which will give them detailed information about an important topic in coral reef ecology/conservation. On the Wednesday afternoon at the end of their stay, they will present their findings to the group in as an imaginative way as possible!

Table 2. Example timetable for Indian Ocean Coral Reef Ecology Course students. Note that this is a guide and the order of activities may change. There may also be changes to this itinerary depending on fitness of students, weather conditions or operational issues on site.

	Day One	Day Two	Day Three	Day Four	Day Five
In-Water Practical	Check dive / check snorkel	Coral ID	Fish ID	Benthic Video Survey	Snorkelling excursion to Nosy Tanikely
Lecture or Land-Based Practical	Lecture 1: An Introduction to Coral Reefs	Lecture 5: Underwater Surveys: Theory & Execution	Lecture 3: Reef species and interactions	Benthic video analysis	
Lecture or Land-Based Practical	Introduction to group project presentations	Benthic quadrat workshop	Reef complexity workshop and transect briefing	Coral Watch briefing	
Lunch					
In-Water Practical	Buoyancy skills / duck-diving	Benthic quadrats	Practice transect laying	Coral Watch survey	Beach clean-up
Lecture or Land-Based Practical	Lecture 2: Importance of Coral Reefs	Benthic quadrat analysis	Lecture 4: Reef Threats and Mitigation Attempts	Lecture 6: Mangroves and Seagrasses	Group project presentations
Lecture or Land-Based Practical	ID Lecture 1: Coral & Invertebrates	ID Lecture 2: Fish	Benthic video briefing	Coral Watch data entry and debate session	
Dinner					
Evening Activity	Games Night	Movie Night	Documentary Night	Quiz Night	Photo competition

7. SSI open water diver course

This course consists of three different elements of learning; dive theory (knowledge development), confined water dives and open water dives. Each component plays its own role in the students' development to meet the performance requirements and objectives they need to become a qualified diver.

Please be aware that as a part of the SSI Open Water Course, all students will be required to complete some basic stamina tests on site. Student divers will need to demonstrate that they can comfortably maintain themselves in water too deep in which to stand by completing a 10-minute swim/float without using any swimming aids. Students will also have students complete a 200m continuous surface swim or a 300 m swim with mask, fins and snorkel.

Table 3. Example timetable for SSI Open water students. Note there may be changes to this itinerary depending on progression through the course, fitness of students, weather conditions or operational issues on site.

Time	Day 1	Day 2	Day 3	Day 4	Day 5
AM	Theory Session & Swim Test	Lecture 2: Importance of Coral Reefs <i>Or keep reading theory</i>	ID Lecture 2: Fish <i>Or keep reading theory</i>	Final Exam	Snorkelling excursion to Nosy Tanikely
AM	Confined Water Session	Confined Water Session	Open Water Dive 2	Open Water Dive 4	
PM	Lecture 1: Introduction to Coral Reefs <i>Or keep reading theory</i>	ID Lecture 1: Coral & Invertebrates <i>Or keep reading theory</i>	Lecture 3: Reef Species and Interactions <i>Or keep reading theory</i>	Lecture 4: Reef Threats and Mitigation Attempts	Beach clean-up
PM	Confined Water Session	Open Water Dive 1	Open Water Dive 3	Fun Dive (or catch-up dive)	Admin session for certification
Evening Activity	Games Night	Movie Night	Documentary Night	Quiz Night	Photo competition

8. SSI open water referral course

For those students who have completed both the dive theory and confined water sessions prior to expedition they can complete their Open Water Referral Course on site. The students will first complete a check dive with their instructor to demonstrate that they still remember and can confidently perform the necessary skills to progress on to complete their open water dives.

Once referral students have successfully completed the final stages of their SSI Open Water course, they will be able to progress on to the Indian Ocean Coral Reef Ecology course. Although there will not be enough time to run the full course, referral students will be able to join at a stage where they can get the chance to learn about the application of survey techniques in the marine environment and how that supports the management of coral reefs.

9. Reef ecology lectures

Lecture 1: Introduction to Coral Reefs

- Assessing current knowledge of marine ecosystems
- How the world learns about science and the environment
- The concept of charismatic species
- Introduction to hard and soft corals
- Coral anatomy, feeding and reproduction

Land-based activity: Group research project
briefing In-water activity: Check dive/snorkel

Lecture 2: Importance of Coral Reefs

- Discussing how coral reefs are important (biodiversity, productivity etc.)
- Furthering examples with fisheries and coastal protection
- How does tourism contribute to importance?
- How coral reefs are distributed globally
- The intermediate disturbance hypothesis

Land-based activity: Reef Complexity
In-water activity: Buoyancy skills

Lecture 3: Reef Species and Interactions

- Defining interaction types
- Discussing competition, predation and symbioses
- Deep dive into parrotfish (discussing their importance and interactions)
- Deep dive into butterflyfish (discussing their importance and interactions)
- Deep dive into damselfish (discussing their importance and interactions)

Land-based activity: Debate Session
In-water activity: Coral and invertebrate ID

Lecture 4: Reef Threats and Mitigation Attempts

- Required conditions for coral growth and survival
- Threats to coral reefs
- Outlining ocean acidification, unsustainable fishing practices and phase shifts
- Ecological resilience
- The future of coral reefs

Land-based activity: Quadrat Building

In-water activity: Fish ID

Lecture 5: Underwater Surveys: Theory and Execution

- What is marine monitoring, and what considerations need to be made?
- An introduction to the benthic environment (benthos)
- How can the benthic environment be surveyed?
- An introduction to the midwater environment (fish)
- How can the benthic environment be surveyed?

Land-based activity: Analysing Quadrat Data

In-water activity: Benthic Assessment Using Quadrats

Lecture 6: Mangroves & Seagrasses

- Introduction to mangroves
- Adaptations of mangroves to their environment
- Introduction to seagrasses
- Adaptations of seagrasses to their environment
- Ecosystem functions of mangroves and seagrasses

Land-based activity: Benthic Video Analysis

In-water activity: Benthic Assessment Using Video

ID Lecture 1: Invertebrates and Corals

- Sponges
- Non-sessile invertebrates
- What is an invertebrate / coral?
- Defining ecosystem architects
- Coral morphologies

ID Lecture 2: Fish

- There is no such thing as a fish!
- How do we describe fish?
- The different body shapes
- How to describe markings / patterning
- Examples of local reef fish

10. Links to A Level

The following tables (Tables 4 & 5) highlights how your Opwall expedition relates to the AS and A level syllabuses across all exam boards. The red and blue blocks indicates that the keywords listed are covered on our expedition (through lectures, practicals or in discussion topics) and that these keywords are also within AS or A level topics as shown.

Table 4: Highlighted in Black are topics that you might experience at your research site. Key: C = Cambridge. Pre-U, C.int = Camb. Int. CCEA = N.Ireland; Ed/Sal = Edexcel Salters, S= SQA; Edex = EdExcel; IB = International Bacc; AP=Advanced Placement (v. 20/11/14)

Topic	Biology	AQA		C	CCEA		C.Int		Ed/Sal		OCR		SQA		WJEC		AP	IB
		S	2		S	2	S	2	S	2	S	2	H	AH	S	2		
	Levels: S=AS 2=A2 H=Highers																	
Evolution, Classification and DNA	Evolution; Speciation; Species; Endemism; Gene pool; Allopatric; Sympatric; Isolation; Variation; Adaptive radiation Adaptation; Wallace; Darwin		◆	◆		◆		◆	◆		◆		◆	◆		◆	◆	◆
	Classification; Taxonomy; Binomial system; Dichotomous Keys	◆		◆	◆			◆	◆	◆	◆		◆		◆			◆
	PCR; Genome sequencing; Genetic fingerprinting; DNA profile		◆	◆	◆					◆		◆	◆			◆	◆	◆
Ecology and Ecosystems	Ecology; Habitat; Niche; Abiotic; Biotic		◆	◆	◆		◆		◆	◆	◆					◆	◆	◆
	Biome; Ecosystems; Rainforests; Deserts; Coral reefs; Mangroves; Marine; Coasts; Hot arid; Semi-arid; Woodland Bush; Tropics; Tropical		◆	◆		◆	◆					◆				◆	◆	◆
	Populations; Competition; Interspecific; Intraspecific; Predator Prey; density dependent; independent: Symbiosis		◆	◆		◆	◆					◆				◆	◆	◆
	Succession; Climax community		◆			◆				◆	◆	◆				◆		◆
	Biodiversity	◆		◆	◆			◆	◆	◆	◆				◆		◆	◆
	Practical work; Field techniques; Ecological sampling; Random sampling; Transects; Capture, mark, release and recapture; Biodiversity indexes; Data handling and; presentation; Quadrats; Statistical testing; Measuring; GIS; Research tools		◆	◆		◆				◆	◆	◆	◆	◆		◆	◆	◆
	Written reports; Research project; Report; Case studies			◆					◆				◆	◆		◆	◆	◆
Agriculture, Human activities, Conservation and Sustainability	Sustainability	◆		◆					◆	◆		◆				◆		
	Agriculture; Agricultural impact; Agricultural exploitation; Cultivation crops; Food production; Sustainable agriculture; Sustainability; Forestry; Timber; Deforestation; Fisheries; Over fishing; Deforestation; Human management; Human effects; Human activities	◆				◆						◆	◆			◆	◆	
	Fair-Trade; Coffee; Rain Forest Alliance; Ecotourism; Tourism; Carbon trading; Greenhouse gas emission control (REDD)															◆		
	Indicator species; Pollution; Climate change; Global warming Carbon footprint; Fossil fuels		◆	◆		◆				◆	◆		◆				◆	◆
	International conservation; Endangered species; Invasive species; Biological control; Pests; CITES; Ethical, Local; Global	◆	◆	◆		◆		◆			◆	◆	◆			◆		◆
	National Parks; Wildlife reserves							◆										◆
	Environment; Environmental monitoring; Environmental impact; SSSI																	
	Animal behaviour; Primate Social behaviour; Courtship; Territory; Co-operative hunting; Herbivores; Grazing	◆		◆	◆			◆				◆	◆	◆		◆	◆	◆

Table 5: Highlighted in Black are topics that you might experience at your research site. Key: IB ESS = Env Systems and Societies; APES = Advanced Placement Env. Science (v. 20/11/14)

Topic	Environmental Science APES and ESS	IB ESS	APES	UK Geography A Levels AQA, Edexcel, eduqas and OCR
Evolution, Classification and DNA	Evolution; Speciation; Species; Endemism; Gene pool; Allopatric; Sympatric; Isolation; Variation; Adaptive radiation Adaptation; Wallace; Darwin	◆		There has been a complete revision of UK Geography A levels. Although our expeditions are possibly not going to be as relevant to Geographers as they are to Biologists there are a significant number of topics covered by the various examination boards in which matching occurs with reference to: • human impact on ecosystems • ecosystems in general • biodiversity • sustainability • fair trade • work of NGOs • deforestation • GIS • carbon trading • climate change • case studies linked to biomes such as rainforests.
	Classification; Taxonomy; Binomial system; Dichotomous Keys			
	PCR; Genome sequencing; Genetic fingerprinting; DNA profile			
Ecology and Ecosystems	Ecology; Habitat; Niche; Abiotic; Biotic	◆	◆	All exam boards expect experience of field investigation techniques, statistical use and data manipulation which are very relevant to their experiences whilst on location at their expedition site. Almost all boards now require an independent investigation by students which fits really well with the present IRPs although the topic chosen must relate to their exam syllabus so topics such as the REDD scheme are possible choices. Their IRPs are between 3,000 and 4,000 words and should take up 4 days minimum to achieve. AQA have defined primary data as “Primary data is defined as unmanipulated data, either collected in the field or a raw dataset” which will work well with past data sets and the research data they help to collect when on their expedition. Specific detailed exam board matching is available on request.
	Biome; Ecosystems; Rainforests; Deserts; Coral reefs; Mangroves; Marine; Coasts; Hot arid; Semi-arid; Woodland Bush; Tropics; Tropical	◆	◆	
	Populations; Competition; Interspecific; Intraspecific; Predator Prey; density dependent; independent: Symbiosis	◆	◆	
	Succession; Climax community	◆		
	Biodiversity	◆	◆	
	Practical work; Field techniques; Ecological sampling; Random sampling; Transects; Capture, mark, release and recapture; Biodiversity indexes; Data handling and; presentation; Quadrats; Statistical testing; Measuring; GIS; Research tools	◆	◆	
	Written reports; Research project; Report; Case studies	◆	◆	
Agriculture, Human activities, Conservation and Sustainability	Sustainability	◆	◆	Almost all boards now require an independent investigation by students which fits really well with the present IRPs although the topic chosen must relate to their exam syllabus so topics such as the REDD scheme are possible choices. Their IRPs are between 3,000 and 4,000 words and should take up 4 days minimum to achieve. AQA have defined primary data as “Primary data is defined as unmanipulated data, either collected in the field or a raw dataset” which will work well with past data sets and the research data they help to collect when on their expedition. Specific detailed exam board matching is available on request.
	Agriculture; Agricultural impact; Agricultural exploitation; Cultivation crops; Food production; Sustainable agriculture; Sustainability; Forestry; Timber; Deforestation; Fisheries; Over fishing; Deforestation; Human management; Human effects; Human activities	◆	◆	
	Fair-Trade; Coffee; Rain Forest Alliance; Ecotourism; Tourism; Carbon trading; Greenhouse gas emission control (REDD)	◆		
	Indicator species; Pollution; Climate change; Global warming Carbon footprint; Fossil fuels	◆	◆	
	International conservation; Endangered species; Invasive species; Biological control; Pests; CITES;	◆		
	Ethical, Local; Global			
	National Parks; Wildlife reserves			
Behaviour	Environment; Environmental monitoring; Environmental impact; SSSI	◆		Specific detailed exam board matching is available on request.
	Animal behaviour; Primate Social behaviour; Courtship; Territory; Co-operative hunting; Herbivores; Grazing			

11. IRPs or Individual Research Projects

In the last few years an increasing number of students joining our research programmes take this opportunity to undertake IRPs. These research projects take many different forms, but what they all have in common is the need to pose and answer a research question. Examples of these include Extended Project Qualification (EPQ), Extended Essay (EE) for IB, as well as many different projects specific to various education systems worldwide.

We can support a selection of different topics for either essay-based research projects or data-led research projects that are tailored towards what the students will experience on site. It is a fantastic opportunity for a student to witness first-hand many of the aspects of their research question and, in many cases, they will have access to samples of past datasets for their project. Students may also have the opportunity to talk with the actual scientists involved which will give them a convincing 'slant' to the way in which they answer their research question.

For success with IRPs, careful planning is needed by the student and a lot of the work will be done prior to their expedition. They will need close guidance from their school supervisor, and the scientists in the field need to be briefed so that support can be provided where they can. If you or your students are interested in undertaking a research project with us, you should contact schoolresearchprojects@opwall.com.

For more information visit the Opwall website - <https://www.opwall.com/schools/educational-benefits/independent-research-project/>.

Books

Bradt H (2020) Madagascar 13 (Bradt Travel Guide).Bradt Travel Guides; 13 edition.

Morris P, Hawkins F, Andrews M (1998) Birds of Madagascar: A photographic guide. Pica Press

Garbutt N (2007) Guide to the Mammals of Madagascar. Christopher Helm Publishers Ltd.

Mittermeier RA, Konstant WR, Hawkins F and Louis EE (2010) Lemurs of Madagascar.Conservational International US 3rd Edition.

Glaw F and Vences M (2006) Field guide to the amphibians and reptiles of Madagascar.Vences & GlawVerlagGbR 3rd edition.

Schuurman D, Bradt H, Garbutt N (2003) Madagascar Wildlife: A visitors guide. Bradt Travel Guides 2nd Edition.

Mittermeier RA, Louis E, Richardson M and Konstant W (2008) Lemurs of Madagascar. Conservation International.

Sutherland WJ (2006) Ecological Census Techniques:A Handbook (2nd Edition). Cambridge University Press, Cambridge.

Internet

Field Checklist of the Birds of Madagascar: www.madagascar-library.com/r/1740.html

Guides for Madagascar – Use search facility (type guides): www.madagascar-library.com/search.html

Research areas and activities being carried out in Madagascar:

- Niche separation and the impacts of disturbance on avian communities in dry forest, Madagascar
- Acoustic techniques for monitoring forest birds
- Bird point counts and mist
- Wetland birds by boat: survey follows a route through mangroves and out into an estuary with mud flats recording all the wetland bird species
- Forest structure plots: measurements to estimate the amount of carbon stored in woody vegetation
- Forest land tenure and conservation revenue sharing in protected areas of northern Madagascar
- Economic impacts of tourism and conservation in the Mahamavo forests, northern Madagascar
- Assessment and valuation of ecosystem service provision in Madagascar
- Tree biodiversity and ecosystem function
- Spatial behavioural ecology of the Malagasy Giant Hognose snake
- Thermal ecology and UV-B requirements of chameleons, skinks and geckos
- Colour and colour change in the chameleons, Uroplatus geckos or Phelsuma geckos of Mahamavo
- Population ecology of Nile crocodiles in Madagascar
- Population ecology of colubrid snakes or chameleons in Madagascar
- Microhabitats and niche partitioning in chameleons, skinks, geckos or snakes in Madagascar
- Herpetofauna routes: sample routes scanning the vegetation and ground carefully for reptiles and amphibians
- Herpetofauna routes: Spotlight surveys are also done in the evening
- Occupancy modelling for nocturnal lemurs, carnivores and bush pigs with camera traps in Madagascar
- Small mammal trapping: Small mammal traps are baited and set in the evenings and students will then check traps and help process any captures in a morning session
- Monitoring bat populations in Madagascar using acoustic methods
- Microhabitat analysis of mangrove forests in the Mahamavo watershed
- Demography and spatial ecology of the endangered Coquerel's sifaka
- Ecology and behaviour of nocturnal lemurs in the dry deciduous forests of north western Madagascar
- Lemur routes Groups walk slowly scanning the canopy closely for groups of lemurs.
- Species distribution modelling in Madagascar
- Landscape ecology in Madagascar
- Community ecology in Madagascar
- Ecology of leaf litter ants
- Developing monitoring protocols for REDD in Madagascar
- Evaluation of biodiversity monitoring methods in Madagascar
- Reef fish and coral communities in Nosy Be, Madagascar